

REMARKS

This is a full and timely response to the outstanding nonfinal Office Action mailed January 31, 2003. Reconsideration and allowance of the application and presently pending claims, as amended, are respectfully requested.

Present Status of Patent Application

Upon entry of the amendments in this response, claims 1-53 remain pending in the present application. More specifically, claims 1, 5, 8, 11, and 25 are directly amended, and claims 29-53 remain withdrawn from consideration. These amendments are specifically described hereinafter. It is believed that the foregoing amendments add no new matter to the present application.

Response To Objections/Rejections

Response To Claim Objections

Claims 11 and 25 were “objected to because of the following informalities: In claim 11, line 2, deletion of the first occurrence of ‘silica’ and in claim 25, line 2, substitution of “and” with --an-- are suggested for correctness.” *Office Action* at 2. Applicants have complied with the amendments the Examiner kindly suggested for claims 11 and 25, and therefore request that the objections be withdrawn.

Response To Claim Rejections Under 35 U.S.C. Section 103(a)

(1) Claims 1-12 and 15-28 have been rejected under 35 U.S.C. Section 103(a) as purportedly being obvious over Gilleo et al. (U.S. Patent No. 6,194,788) in view of Lin et al. (U.S. Patent No. 6,207,475). Applicants respectfully submit that the combination of Gilleo et al. in view of Lin et al. fails to establish a *prima facie* case of obviousness and, therefore, request reconsideration of this rejection.

(a) **There is No Motivation to Combine Gilleo et al. and Lin et al.**

There is no suggestion or motivation in the references to combine the Gilleo et al. and Lin et al. references. In order to establish the *prima facie* case of obviousness, the

Examiner must establish a suggestion or motivation either in the references themselves, or in the knowledge generally available to one of ordinary skill in the art to modify the reference or combine reference teachings in order to result in the claimed invention. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984). In the present case, the *prima facie* case of obviousness has not been established because there is no suggestion or motivation in the art to combine Gilleo et al. and Lin et al. The Gilleo et al. and Lin et al. references teach different methods, and each of their methods would not work as taught if combined with the other.

Further, the Office cannot pick and choose among isolated disclosures in the prior art with the invention in mind. This is not only impermissible hindsight reconstruction, but also further evidence of a lack of suggestion or motivation to combine the references. *In re Fine* at 1075. Here, the Office has chosen among isolated disclosures with two different processes in order to allegedly find all of the ingredients found in the present invention. Thus, this is impermissible hindsight reconstruction and proves that there was no suggestion or motivation in these references to combine them.

Additionally, the Board of Patent Appeals and Interferences' rejection of a need for any specific hint or suggestion in the art to combine references was recently held to be legal error. *In re Lee*, 277 F.3d 1338 (Fed. Cir. 2002). The Office "cannot rely on conclusory statements when dealing with particular combinations of prior art and specific claims, but must set forth the rationale on which it relies." *Id.* at 1345. The court stated that the specific teaching that would have suggested the claimed combination must be present, and subjective belief could not be relied on to support the combination of references.

The suggestion to combine Gilleo et al. and Lin et al. is not present in either reference. The configuration of the devices themselves, formed during fabrication, differs in the two references, with no suggestion that the two references could be combined. In Gilleo et al., the flux/underfill material covers the solder bumps when it is applied. See Gilleo et al., FIG. 2 and col. 7, ll. 64-65. Gilleo et al. specifically teach that "[i]n fact, it is preferred that the [underfill] material cover the bumps because, in so doing, the bumps will be protected...." Gilleo et al. at col. 5, ll. 64-66. In contrast, in Lin et al. the underfill material either fills in the area only between the solder balls or

leaves the solder balls exposed on one surface. *See, for example, Lin et al.* at FIGs. 4E and 5D.

In addition to the difference in the structures of the devices of the two references, the process of fabricating the flip-chips also differs, with no suggestion of a motivation to combine the two processes of Gilleo et al. and Lin et al. For example, in Gilleo et al., the underfill material is first applied on the wafer level and the wafer is then diced. *See Gilleo et al.*, col. 4, ll. 3-4 and col 6, ll. 13-23. Contrarily, in each embodiment of Lin et al., the wafer is first diced and then the underfill material is applied to the individual dies. *See Lin et al.* at col. 8, ll. 34-67, and FIGs. 4A and 4E; col. 9, ll. 51-66, and FIGs. 5A and 5B; and col. 10, ll. 33-47, and FIGs. 6A and 6C.

One skilled in the art would not be motivated to combine Gilleo et al. and Lin et al. because they teach different devices and different fabrication methods. Because the Office has cited references that are not properly combinable, no *prima facie* case of obviousness has been established and the rejection of claims 1-12 and 15-28 should be withdrawn.

(b) The Combination of Gilleo et al. and Lin et al. Does Not Render Obvious the Present Claimed Invention

It is well established that, for a proper rejection of a claim under 35 U.S.C. §103 as being obvious based upon a combination of references, the cited combination of references must disclose, teach, or suggest, either implicitly or explicitly, all features/steps of the claim at issue. *See, e.g., In re Dow Chem.*, 5 USPQ2d 1529, 1531 (Fed. Cir. 1988) and *In re Keller*, 208 USPQ 871, 881 (CCPA 1981).

Even if the Gilleo et al. and Lin et al. references are combined, the combination does not render obvious the present independent claim 1.

Independent claim 1, as amended, recites the following:

1. A wafer-level compressive-flow underfilling (WLCFU) process comprising the steps of:

applying a WLCFU material onto a surface of a bumped wafer in an amount sufficient to ensure that the thickness of the solidified WLCFU layer is less than the height of the wafer bumps;
solidifying the WLCFU material;
separating the WLCFU material coated wafer into individual chips;
covering the top of the bumps with a tacky film;
mounting the WLCFU material and tacky film coated individual chips to substrates; and
reflowing the solder bumps and curing the WLCFU material and tacky film simultaneously.

Independent claim 1 is allowable for at least the reason that the combination of Gilleo et al. in view of Lin et al. does not disclose, teach, or suggest the method steps that are highlighted in claim 1 above. More specifically, the combination of the two references does not teach at least the steps of applying an underfill material to a bumped wafer in an amount sufficient to ensure that the thickness of the underfill is less than the wafer bumps, then covering the tops of the bumps with a tacky film, and mounting individual chips coated with the underfill and tacky film to substrates.

There are several deficiencies of Gilleo et al. with respect to the claimed invention. As noted above, Gilleo et al. teach coating the solder bumps of its devices with a single flux/underfill material. During the later baking process, although vaporization of solvent in the flux/underfill material may decrease the thickness of the flux/underfill material to less than that of the height of the bumps, the dried fluxing material coats the tops of the solder bumps as a thin film. Gilleo et al. at col. 6, ll. 3-19. It is inherent in the process of Gilleo et al. that a dent then exists on the solder bumps. The dents on the solder balls will introduce voids in the later assembling process that will severely reduce reliability of the produced package. Additionally, silica filler is normally used in most underfill applications to reduce the coefficient of thermal expansion (CTE) in order to generate greater package reliability. Indeed, Gilleo et al. teach using a silica filler in each of its Examples 1-3. Gilleo et al. at col. 8, ll. 1-39. When the fluxing underfill material of Gilleo et al. includes a silica filler, the dried silica-containing film on the top of the solder bumps will significantly reduce the interconnection yield. Thus, Gilleo

et al. does not solve underfill voiding and low interconnection yield problems of the prior art that are solved, at least in part, by the process of claim 1. If, however, the references are combined, they still do not teach or suggest flip-chip assemblies, as does the process of claim 1.

Lin et al. do not cure the above-deficiencies of Gilleo et al. In particular, as noted above, Lin et al. teach applying the underfill material to the individual dies after the wafer has been diced. Lin et al. do not teach or suggest applying an underfill material to a bumped wafer. Further, Lin et al. teach only applying an underfill material and do not teach the application of a separate tacky film material, as claimed in claim 1. Moreover, because Lin et al. do not teach or suggest applying the underfill material at the wafer level, it also does not teach or suggest mounting individual chips that are coated with the underfill and tacky film to substrates, as claimed in claim 1.

Consequently, the combination of Gilleo et al. in view of Lin et al. does not render claim 1 obvious, and the rejection should be withdrawn.

Because independent claim 1 is allowable over the prior art of record, its dependent claims 2-12 and 15-28 are allowable as a matter of law, for at least the reason that these dependent claims contain all features/elements of their respective independent claim 1. *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988). Additionally and notwithstanding the foregoing allowability of these dependent claims, the dependent claims recite further features and/or combinations of features (as is apparent by examination of the claims themselves) that are patentably distinct from the prior art of record.

(2) Claims 13-14 have been rejected under 35 U.S.C. Section 103 as purportedly being obvious over Gilleo et al. in view of Lin et al., as applied to claims 1-12 and 15-28 above, and further in view of Yonemoto (JP Patent 61-138614).

Claims 13-14 depend from independent claim 1, which is believed to be allowable over the cited references, as argued above. Because independent claim 1 is allowable over the prior art of record, its dependent claims 2-12 and 15-28 are allowable as a matter of law. Additionally and notwithstanding the foregoing allowability of these dependent claims, the dependent claims recite further features and/or combinations of features (as is apparent by examination of the claim itself) that are patentably distinct from the prior art of record.

First, the Examiner has combined non-analogous references. Yonemoto is directed to a method of making phenolic novalac resin. There is nothing that would motivate one searching the art of flip-chip interconnect structures to rely on this reference. Second, because Yonemoto is a non-analogous reference, there is no motivation in this reference or in the Gilleo et al. and Lin et al. references to combine the teachings of all three references. These are isolated disclosures in the art and combining them would result in impermissible hindsight reconstruction. Thus, for at least these reasons as well, Applicants respectfully request that the rejection of claims 13-14 be withdrawn.

CONCLUSION

In light of the foregoing amendments and for at least the reasons set forth above, Applicants respectfully submit that all objections and/or rejections have been traversed and/or accommodated, and that the now pending claims 1-28 now under consideration are in condition for allowance. Favorable reconsideration and allowance of the present application and all pending claims are hereby courteously requested. If, in the opinion of the Examiner, a telephone conference would expedite the examination of this matter, the Examiner is invited to call the undersigned attorney at (770) 933-9500.

Respectfully submitted,

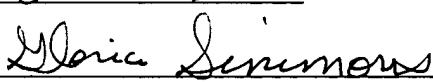


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